Butterfly study sheds light on convergent evolution

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For 150 years scientists have been trying to explain convergent evolution. One of the best-known examples of this is how poisonous butterflies from different species evolve to mimic each other's color patterns – in effect joining forces to warn predators, "Don't eat us," while spreading the cost of this lesson.

Now an international team of researchers led by Robert Reed, UC Irvine assistant professor of ecology & evolutionary biology, has solved part of the mystery by identifying a single gene called optix responsible for red wing color patterns in a wide variety of passion vine butterfly species. The result of 10 years of work, the finding is detailed in a paper that appears online today in the journal *Science*.

"This is our first peek into how mimicry and convergent evolution happen at a genetic level," Reed said. "We discovered that the same gene controls the evolution of red color patterns across remotely related butterflies.

"This is in line with emerging evidence from various animal species that evolution generally is governed by a relatively small number of genes. Out of the tens of thousands in a typical genome, it seems that only a handful tend to drive major evolutionary change over and over again."

The scientists spent several years crossbreeding and raising the delicate butterflies in large netted enclosures in the tropics so they could map the genes controlling color pattern. UCI postdoctoral researcher Riccardo

Papa (now an assistant professor at the University of Puerto Rico, Rio Piedras) then perfected a way to analyze the genome map by looking at gene expression in microdissected butterfly wings.

Finding a strong correlation between red color patterns and gene expression in one small region of the genome was the breakthrough that led to discovery of the gene. Population genetics studies in hybrid zones, where different color types of the same species naturally interbreed, confirmed it.

"Biologists have been asking themselves, 'Are there really so few genes that govern evolution?'" Reed said. "This is a beautiful example of how a single gene can control the evolution of complex patterns in nature. Now we want to understand why: What is it about this one gene in particular that makes it so good at driving rapid evolution?"

Provided by University of California - Irvine